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GRASSES: THEIR USES AND COMPOSITION.

SEPTEMBER, 1893.

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To the Honourable

THE MINISTER OF AGRICULTURE.

SIR,—I have the honour to submit for your approval Bulletin No. 19, of the Experimental Farm series, which has been prepared at my request through the joint labours of Mr. Jas. Fletcher, Botanist and Entomologist, and Mr. F. T. Shutt, Chemist, of the Dominion Experimental Farms.

In this Bulletin will be found information on the characteristics and composition of a large number of grasses, most of which have been grown under the care of the botanist, at the Central Experimental Farm. Many of these are natives of the Canadian North-west, and among them are several which have been tested for several years at the experimental farms at Brandon and Indian Head, and give promise of being very useful for fodder purposes to those engaged in stock raising in Manitoba and the Territories. The illustrations given will aid the farmer in recognizing these useful plants. The relative usefulness of these different grasses depends much on their nutritive constituents. The proportions of these are fully set forth by the chemist in the tables of analytical results, which contain the information which will enable the reader to judge of the comparative value of the species referred to from the North-west, and also of many other species of grasses from Europe and elsewhere, some of which are in use as fodder grasses for hay and pasture lands in many parts of Canada.

The importance of the cattle industry is very great, and it is believed that the information given in this Bulletin will be very useful to stockmen and farmers generally.

I have the honour to be

Your obedient servant,

WM. SAUNDERS,

Director Experimental Farms.

OTTAWA, August 4, 1893.

GRASSES.

THEIR USES AND COMPOSITION.

BY

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It is needless to point out to farmers the enormous importance of the various members of the grass family, which provide food for man and the different kinds of live stock. All the cereals, including Indian corn, wheat, barley, oats, etc., are true grasses; some of them, of course, are of very much more value than others, and probably the good qualities of many of the best have been already recognized; but there are in every country many species of value concerning which nothing or very little is known. The present Bulletin contains notes concerning the agricultural value, as well as a tabulated statement of the composition, of many species of imported and native grasses. Part I treats of species which have been under cultivation and examination at the Central Experimental Farm during the past four years, some of them native species of which previously the agricultural value had not been investigated. Part II treats of grasses from Manitoba and the North-west Territories. There is a general impression among farmers that because a grass is wild, therefore it is useless or at least very much less useful than the imported kinds. This impression, however, is largely erroneous; for it has been found that many of the best European grasses will not thrive in the Canadian climate, owing either to the heat of summer or the cold of winter. Now the bulk of grass seed imported into this country comes direct from Europe, and, as a matter of fact, a farmer wishing

to purchase grass seed other than Timothy, can seldom obtain any excepting that of European grasses. It should not be forgotten, however, that all the grasses which farmers have now under cultivation were once wild grasses and are so still in their original homes.

We have found that several of our native species are well worthy of cultivation as hay and pasture grasses, and are as well suited, if not better, for paying crops in certain parts of Canada as any imported species which can be grown. The requirements of a good grass are: 1st. That it should produce a heavy crop, so as to pay well for the use of the land; 2nd. That it should be hardy, so as to be uninjured by the climate; 3rd. That it should be rich in albuminoids or flesh-forming constituents, and poor in hard, indigestible fibre; and, 4th. That it should be palatable, so as to be relished by stock.

There are no less than 300 kinds of grasses found wild or naturalized in Canada, varying much among themselves in the characters given above. In the experiments here referred to, a few grasses only are mentioned, out of a collection consisting of about 250 different kinds which have been grown and are now being studied. When further data have been obtained, reports will be made public of such information as it is deemed will be of value to the farmers of Canada, either in drawing their attention to the particular points of value in certain grasses, or indicating those species which have shown themselves unsuitable for cultivation as remunerative crops.

It may be noted that some grasses, as, for instance June grass, have great value for pasturage, springing up again rapidly when eaten off, while they give but a light crop of hay, and on the other hand some grasses, although very valuable as hay grasses, provide but a small quantity of food in a pasture, as is the case with Timothy.

There are few farm crops more susceptible to environment than the grasses; many of them, though meagre in growth and poor in quality when wild, have been found to be peculiarly responsive when given thorough cultivation in a rich soil, improving vastly both in yield and nutritive qualities. There are ample scientific data to substantiate the above statement: hence the value of a more careful and liberal culture of pasture and meadow grasses than that at present in vogue in many parts of the Dominion, is obvious.

FODDER CONSTITUENTS.

The analysis of a grass or other fodder includes a determination of (1) water; (2) nitrogen, from which the amount of albuminoids is calculated; (3) fat, or oil; (4) nitrogen-free extract, or carbohydrates; (5) fibre, or cellulose; and (6) ash, or mineral matter.

The nature and function of these constituents, or nutrients, as they are usually called, have been dwelt upon at length in former publications.* It will suffice here to epitomize.

WATER.—Water assists in the preservation of the succulence and palatability of a fodder, and its withdrawal as the plant matures is usually accompanied by an impaired digestibility of the food. In proper proportions, water is essential to the well-being of the animal—to the solution, digestion and assimilation of its food, and to the excretion of its waste products. Since, however, it is so plentiful in nature, it cannot, when compared with other food constituents, be in itself considered a nutrient to which a pecuniary value can be assigned.

ALBUMINOIDS OR PROTEIN.—Under these terms are collected the substances that constitute the nitrogenous portion of the fodder. They are by far the most important and valuable of all the nutrients, since they largely assist in the formation of blood, muscle, bone; they are consequently necessary to the production of milk and flesh. Hence they are known as "flesh-formers." The wastes of the tissues which daily ensue from bodily activity, are repaired from and replaced by the albuminoids of the food. They are under certain circumstances converted into fats of the body, and at times also serve for the production of heat and muscular strength in the animal. Since they are absolutely necessary, not only for milk and beef production, but also for the maintenance of life, the albuminoids cannot be replaced in a ration by any of the other nutrients.

Although all the nitrogen of the present analyses is returned as albuminoids, it should be stated that during the earlier periods of growth a small percentage of it exists (as non-albuminoid nitrogen)

*Report of Chemist in Reports of Dominion Experimental Farms for 1890 and 1892;—Report of Dairy Commissioner, 1891-2, page 102 et seq., etc.

in compounds the exact food value of which has not as yet been determined, but which is usually held to be somewhat less than that of the true albuminoids.

FAT.—This constituent ranks next to the albuminoids in nutritive value. It is readily converted into adipose tissue in the animal. It is one of the chief heat and energy producing ingredients of fodders. It aids the digestion and assimilation of the albuminoids and preserves them in the animal economy from undue waste.

The seeds of many plants are rich in fat or oil. In stems and leaves the percentage is usually very much less.

In ordinary analyses of fodders, the chlorophyl (or green colouring matter), together with other substances extracted by ether, is included in the percentage of fat recorded. Hence, it is sometimes indicated as "crude fat."

NITROGEN-FREE EXTRACT OR CARBOHYDRATES.—Sugar, starch, gum and allied substances are here included. They are known as the "fuel ingredients," supplying, by their combustion in the blood, energy, either as heat or power for work. They are not stored up by the animal.

FIBRE OR CELLULOSE.—Under these terms are designated the substances that constitute the framework of the plant. In chemical composition they are very similar to the carbohydrates mentioned above, and the physiological functions of digestible fibre are likewise of the same character. As a rule, the fibre is much more digestible in the young plant than in the more mature, in the latter it has largely become converted into lignin, which is of a woody nature and for the most part passes through the animal unchanged. Fibre is the least valuable of all the food constituents.

ASH OR MINERAL MATTER.—The inorganic or mineral matter of plants is taken by them from the soil. It consists chiefly of lime, magnesia and potash combined with phosphoric, carbonic and other acids. The composition and amount of ash in plants vary widely, depending largely upon the constituents of the soil and their solubility and upon the nature of the plant. The mineral matter of bones, and the small quantity present in the other tissues, is derived from this source. All food rations contain sufficient to supply the requirements of the animal, hence no particular value is assigned to the "ash" of a fodder.

I.—GRASSES GROWN AT OTTAWA.

In the tables of analyses are to be found the percentages of the nutrients in the green fodders at the time of cutting, and also the figures that represent the composition of the water-free substance—the latter data being calculated and inserted for the sake of facilitating a comparison between the nutritive values of the grasses.

Many of the grasses have been analysed at two stages of growth. The data thus obtained enable the reader to judge of the period when the grass is most nutritious, and consequently of the best time to cut for hay.

The numbers preceding the names of the grasses in the following pages refer to the analyses given in the tables on pages 30 to 35. The analyses of a few kinds of well known grasses are not yet completed; but as some account of them will be looked for in this bulletin, they are put in their alphabetical order without numbers.

Nos. 1 & 2.—*AGROPYRUM CANINUM*, R. & S. (Bearded Wheat Grass).

A native perennial grass found growing in clumps on gravelly banks and prairie benches, about 4 feet in height. Although of the same family as Quack grass, it never produces the running root-stocks which make this latter such a pest to the farmer. When bruised it has a strong odour, but is well liked by cattle. Flowering period, July 1 to 15. Analysis shows it to be rich in albuminoids during the early stages of growth.

Nos. 3 & 4.—*AGROPYRUM GLaucum*, R. & S., var. *OCCIDENTALE*, V. & S. (Colorado Blue-stem).

Native, perennial. Height, $2\frac{1}{2}$ feet. One of the most valuable grasses of the western plains, where it is the chief grass of the cattle ranches. It produces an abundance of fine leaves from running root-stocks and seeds freely. Flowering period, July 5 to 15. Not a heavy yielder; best suited for pasture. Owing to its running root-stocks, it cannot be recommended where alternate husbandry is practised. The analytical data show that it makes a highly nutritive feed.

No. 5.—*AGROPYRUM REPENS*, Beauv. (Quack, Scutch or Couch).

Well known throughout Canada as an agricultural pest on account of its vigour of growth and creeping root-stocks, which render it

difficult to eradicate. When green it is much relished by cattle, and if cut when in flower, produces rich hay. After a few years, however, it fills the soil with matted roots and yields sparingly, so that it can only be regarded as a weed. From the analysis, it is apparent that the grass has considerable nutritive value.

No. 6.—*AGROPYRUM TENERUM*, Vasey (Western Rye Grass).

Native, perennial, growing in low lands and on prairie benches, from Manitoba west to the Pacific. Height, 3 to 4 feet. Flowering period, July 1 to 15. This grass has succeeded remarkably well under cultivation and is one of the best western hay grasses, producing a large number of leaves, and straight, slender stems. It is an early grass and does well on heavy soil, even when impregnated

slightly with alkali. Judging from its composition, it compares very favourably with the other members of the family, being of good quality and nutritious.



Fig. 1.—Red Top.

No. 7.—*AGROSTIS VULGARIS*, With. (Red Top).—Fig. 1.

Introduced, but now spontaneous everywhere, perennial, particularly suitable for low lands, where it should always find a place in permanent pasture mixtures. It makes a firm sod, and in good soil produces a fair crop of fine, soft hay. Flowering period, June 28 to July 10. Height, $2\frac{1}{2}$ to 3 feet. Undoubtedly a valuable grass, but not so high in albuminoids as some of the other grasses here treated.

No. 8.—*AGROSTIS DISPAR*, Mx.

Very similar to the above in habit and composition, but of freer and more vigorous growth.

No. 9.—*ALOPECURUS PRATENSIS*, L. (Meadow Fox-tail).

Introduced from Europe. An early, perennial grass of good quality, but requiring a rich soil, moist climate, and three or four years to come to perfection. Does not produce a heavy crop of hay, but is valuable for pastures on account of earliness, rapidity of growth after cutting and rich aftermath. It is grown to some extent in the Maritime Provinces under the name of "French Timothy." Flowering period, June 10 to 20. Height, $2\frac{1}{2}$ to 3 feet.

ANTHOXANTHUM ODORATUM, L. (Sweet Vernal Grass).

A very sweet-scented introduced grass, highly esteemed in Europe for its earliness and the sweetness it imparts to hay. Our experiments with it in this country will not justify our recommending it, as it has not proved hardy enough.

AVENA ELATIOR, L. (Tall Oat Grass).

A tall slender European grass, useful in permanent pasture mixtures, but not suitable for growing alone. It flowers about the same time as Timothy and produces a good aftermath of slender leafy stems. Height, 3 to 4 feet. This grass is also sometimes called *Arrhenatherum avenaceum*, Beauv.

AVENA FLAVESCENS, L. (Yellow Oat Grass).

A slender grass, introduced from Europe, highly spoken of for mixtures, but of small size and slow growth. Height, 3 feet.

No. 10.—*BOUTELOUA OLIGOSTACHYIA*, Torr. (Gramia Grass).

A small native perennial grass of the western prairies. Highly nutritious and much relished by cattle. Not adapted to cultivation in the east, but stated by Dr. Vasey to be the main reliance of stock-feeders on the arid plains of the Western States. Flowering period, July 1 to 15. Height, 1 foot. Our analyses of plants grown at Ottawa confirm the high opinion expressed above.

No. 11.—*BROMUS CILIATUS*, L. (Fringed Brome Grass.)

Native, perennial. A tall, leafy grass found in woods and along river banks. Not generally recognized as of much agricultural

value, but reported as a promising hay grass in Manitoba and the North-west Territories. Flowering period, July 10 to 20. Height, 3 to 5 feet.

No. 12 & 13.—*BROMUS INERMIS*, Leyss. (Awnless Brome, Austrian Brome Grass).—Fig. 2.



Fig. 2.—Awnless Brome Grass.

Introduced, perennial, conspicuous for its free leafy growth and tall stems, which bear an abundance of seed. Very hardy, early, a heavy cropper and producing a good aftermath of succulent leafy shoots. Reports received from all parts of Canada speak very highly of this newly introduced grass. It thrives well in any loose soil and withstands droughts, but produces a much heavier crop in rich, damp land. We consider this one of the most valuable of the introduced grasses, both from its feeding qualities as evinced by the analysis, and from its free luxuriant habit of growth. It must, however, be remembered that it makes long underground rootstocks which are difficult to eradicate. Flowering period, June 25 to July 10. Height, 3 to 5 feet.

BROMUS SECALINUS, L. (Chess).

This grass is grown in the Pacific States on alkaline lands, where it is said to produce a heavy crop of good hay. In the East it is considered a pernicious weed.

Chess is an annual, the seed germinating in the autumn and flowering stems appearing the next summer. Height, 2 to 3 feet. The idea that this grass is degenerated wheat is entirely without foundation.

No. 14 & 15.—*BROMUS PUMPELLIANUS*, Scrib. (Western Brome Grass).—Fig. 3.



Fig. 3.—Western Brome grass.

A native, perennial, found on river banks and coulee margins from Manitoba to British Columbia. This is a valuable grass, producing an abundance of leafy stems, continuing in flower a long time and giving a heavy aftermath. It spreads rapidly from the root and, with the exception of a somewhat smaller yield closely resembles in all particulars the Awnless Brome grass. Flowering period, June 20 to July 15. Height, 3 feet.

No. 16.—*BROMUS SEGETUM*, Schl.

An introduced annual from Mexico. This grass will bear twice cutting and will then seeditself for the next year. The yield of hay is not heavy enough to give it much agricultural value. Flowering period, July 1 to 10. Height, 2 feet. The analysis of this grass, made while in flower, proves it to be especially rich and nutritious.

No. 17.—*BUCHLOE DACTYLOIDES*, Engelm. (Buffalo Grass).

A perennial grass of small size, forming thick mats of hair-like foliage, three or four inches in depth. Found throughout the arid region of the western plains of the United States, where it is highly esteemed from the important part it plays in feeding and fattening vast herds of cattle. It is probable that it will be found along the southern border of our prairie region. This is known distinctively as the "true Buffalo grass" from the supposition that it was the favourite of the American Bison. This grass is not suitable for cultivation in the east as it starts very late in spring, not showing a sign of life until June. In the west it thrives on all classes of soils

and provides a rich and palatable food during the greater part of the year, stock relishing it equally well in the dry or fresh condition. Flowering period, June 20 to September.

No. 18.—*CERATOCHLOA AUSTRALIS* (Southern Brome Grass).

Seed imported from Germany. This is probably identical with Schrader's Brome grass, which is again supposed to be the same as *Bromus unioloides*, Willd. A free growing annual, which produces a large amount of succulent fodder of rich quality. It shoots up again quickly after cutting and continues growing until killed by winter. Flowering period, July 5 to 20. Height, 2 to 3 feet.

No. 19.—*CINNA PENDULA*, Trin. (Drooping Reed Grass).

A slender, leafy, native grass, found in swamps and mountain woods. Difficult to cultivate and therefore of no agricultural value, although its analysis shows it to be a rich grass. Flowering period, July 5 to 20. Height, $2\frac{1}{2}$ to 3 feet.

DACTYLIS GLOMERATA, L. (Orchard Grass, Cock's Foot).

A valuable agricultural grass where it will grow. Originally introduced from Europe, where it is one of the most highly esteemed of all fodder plants. Particularly suitable for growing in orchards and under trees. It requires rich soil, on which it produces a heavy crop both of hay and pasture. The hay must be cut early, or it becomes hard and woody. In pastures also it requires to be fed closely. Flowering period about the same as Timothy and Clover. Height, 3 feet.

No. 20.—*DESCHAMPSIA CÆSPITOSA*, Beauv. (Tufted Hair Grass).

Native, perennial. A beautiful grass, but of no economic value, with very short leaves and tall, feathery panicles of silvery flowers. Flowering period, July 1 to 10. Height, $2\frac{1}{2}$ feet.

No. 21.—*DESCHAMPSIA CÆSPITOSA*, Beauv., var. *BOTTNICA*, Vasey (Rocky Mountain Hair Grass).

This variety, although of no special agricultural value, is far superior to the above. It grows in tufts like the last, but bears fewer flowering stems and many more and longer (18 inches) dark green leaves. Flowering period, July 1 to 15. Height, 3 feet.

No. 22.—*DEYEUXIA CANADENSIS*, Hook. (Canadian Blue-joint).—

Fig. 4.



Fig. 4.—Canadian Blue-joint.

ing, like Canadian Blue-joint, from the Atlantic to the Pacific.

No. 23.—*DEYEUXIA NEGLECTA*, Kunth. (Neglected Blue-joint).

Native, perennial. This valuable grass of the prairies has succeeded well under cultivation, producing great quantities of long, fine leaves and seeding freely. It forms a large proportion of the grass of the prairies in some districts, and Mr. Bedford, Superintendent of the Experimental Farm for Manitoba, states that, although the hay is rather coarse, ponies will wander long distances cropping the dry stems in preference to many other grasses. Flowering period, June 25 to July 10. Height, 3 feet. Analysis shows it to possess nutritive qualities of a high degree.

No. 24.—*ELEUSINE INDICA*, Gærtn. (Crow-foot, Yard Grass).

An annual introduced from Asia, producing a medium crop of rather coarse fodder. It probably will not take the place of several other annual grasses now in cultivation. Flowering throughout the season. Height, 1 to $1\frac{1}{2}$ feet. It is rich in albuminoids.

No. 25.—*ELYMUS VIRGINICUS*, L. (Lyme Grass, Smooth Rye Grass).

Native, a luxuriant perennial, giving a heavy crop of succulent green fodder during June and July. It must be cut early, or the hay becomes coarse and harsh. Thrives best in rather moist soil. Flowering period, July 10 to 25. Height, 4 feet. Although the analysis was made at what was considered the best stage of growth, our figures do not place this grass very high in nutritive qualities.

No. 26.—*ERAGROSTIS ABYSSINICA*, LINK. (Teff).

An introduced annual from India and the East, where the seed forms an important article of food. It produces a very heavy crop of feed, of medium quality, which is eaten by cattle, but apparently without much relish. The seed does not ripen until October, and the vitality of Canadian grown seed lessens rapidly year by year. Flowering period, August. Height, 3 feet.

FESTUCA DURIUSCULA, L. (Hard Fescue).

A hardy fine-leaved grass suitable for rocky pastures.

Nos. 27 & 28.—*FESTUCA ELATIOR*, L. (Tall Fescue).—Nos. 29 & 30.
—*FESTUCA PRATENSIS*, L. (Meadow Fescue).

Introduced from Europe; perennials and among the best adapted to cultivation in Canada. Both of these grasses are perfectly hardy, and produce heavy hay crops of good quality. They also provide excellent pasture in early spring and late autumn. The Meadow Fescue is now considered merely a variety of the Tall Fescue. It is of a more slender habit and does not yield quite so heavily, but the hay is finer. These nutritive and productive grasses should always be included in permanent pasture mixtures. Flowering period, June 20 to 30. Height, $2\frac{1}{2}$ to 4 feet. In *Festuca pratensis* we find an exception to the fact that the percentage of albuminoids decreases between the periods of "just speared" and "seed formed." Our analyses show no deterioration in nutritive qualities during that time.

FESTUCA OVINA, L. (Sheep's Fescue).

A small but valuable grass for upland or rocky pastures.

No. 31.—*HIEROCHLOA BOREALIS*, R. & G. (Holy Grass, Indian Hay).



Fig. 5.—Holy grass.

Native,* perennial. One of the earliest grasses, flowering by the middle of May. It is very sweet-scented, and when cut or fed off, keeps continually producing young leaves. A small quantity in hay imparts a very sweet odour to the other grasses. When once established, however, it is very persistent, and in Manitoba is rapidly becoming a noxious weed most difficult to eradicate. It cannot therefore in any case be recommended for cultivation there and should be introduced everywhere with caution. Our analyses prove it to be a very rich grass. Horses and cattle eat it readily.

This is the grass of which the leaves are used by the Indian women to weave the scented "Indian Hay" baskets and mats. The name Holy-Grass is derived from an ancient European custom of strewing it about churches on festival days. It is dedicated to the Virgin Mary on account of its sweetness.

No. 32.—*HOLCUS LANATUS*, L. (Velvet Grass.)

Introduced, perennial. A fine growing grass covered with soft whitish hairs. Although the chemical analysis shows that it has considerable nutritive value, its cultivation cannot be recommended, as it is too tender for the Canadian winter, and cattle do not eat it readily.

Nos. 33 & 34.—*KŒLERIA CRISTATA*, Pers. (Western June Grass).

Native, perennial. A poor bunch grass of the western plains, not touched by cattle when anything else is obtainable. Flowering period, June 20 to 30. Height, 2 feet. From its composition, however, as depicted in the subjoined table, it does not appear to be wanting in nutritive qualities.

LOLIUM ITALICUM, Braun (Italian Rye-grass).

A succulent annual grass suitable only for mixtures intended for one year's crop.

No. 35.—*LOLIUM PERENNE*, L. (Perennial Rye-grass).

Introduced. This standard European grass is not sufficiently hardy to stand the climate in most parts of Ontario and Quebec, and cannot be advantageously introduced into pasture mixtures which are required to last for more than one year. Where the climate will permit of its being cultivated, it is a valuable and nutritious grass.

In this latter respect our present analysis places it below the average.



Fig. 6.—Wild Timothy.

No. 36.—*MÜHLENBERGIA GLOMERATA*, Trin. (Wild Timothy.)—Fig. 6.

Native, perennial. This grass resembles Timothy somewhat in the general appearance of the head, but not in other respects. It has a much branched erect stem, is a heavy cropper, and produces nice, fine hay, highly relished by cattle and horses. One of its special characters is its late flowering. It is very hardy and will grow almost anywhere, although thriving best on low land. Flowering period, August 6 to 20. Height, 3 feet.

No. 37.—*MÜHLENBERGIA MEXICANA*, Trin. (Satin Grass).

Native, perennial. Like the above, but producing finer hay. Its leafy stems branch at every joint, and it seems to have all the characters of a good hay grass. In good land, it is a heavy cropper, producing from $2\frac{1}{2}$ to 3 tons per acre of hay of high quality. Flowering period, August 6 to 20. Height, 3 feet.

MÜHLENBERGIA SYLVATICA, T. & G. (Bearded Satin Grass).

This grass resembles *M. Mexicana* closely, but has longer stems and produces a heavier crop of hay. The flower panicle is looser and bears slender bristly awns. It has succeeded well in low rich land.

No. 38.—*PANICUM CILIARE*.

Annual. Seed received from India. A grass closely resembling Crab grass, *Panicum sanguinale*, L. Not worthy of cultivation in this country where we can grow many heavier and better grasses.

No. 39.—*PANICUM CRUS-GALLI*, L. (Barn-yard Grass).

Native, annual. A tall, coarse grass producing a great quantity of succulent feed, which is highly relished by stock. It grows in low land and around dwellings throughout the country. Flowering period, August. Height, 3 feet. In the early stages of growth it is excellent and nutritious feed; but as it reaches maturity, in common with most grasses, deteriorates rapidly, indeed somewhat more rapidly than any other.

No. 40.—*PANICUM VIRGATUM*, L. (Switch Grass).

Native, perennial. A late coarse grass, producing heavily and suitable for low land. It must be cut young, as the stems become very hard later in the season. Flowering period, August 5 to 20. Height, 3 to 5 feet. The present analysis does not place it among the most nutritious of those examined.

Nos. 41 & 42.—*PHALARIS ARUNDINACEA*, L. (Reed Canary Grass.)

Native, perennial. This is the wild form of the well known Ribbon grass of gardens. A luxuriant low land grass, which gives a heavy crop of green leafy stems, over 3 feet high by the 1st of June. If

cut at that time, a second cutting may be made by the 1st of August. This grass grows wild in all parts of Canada in swamps and wet places. The seed, which resembles Canary seed, is not very freely produced, but in suitable soil the plants increase rapidly from their roots; however, it is not a difficult species to eradicate, like some other grasses with this habit. The harsh and fibrous character of the mature grass precludes its recommendation save for soilings when cut early and for use in swampy pastures.

Nos. 43 & 44.—*PHLEUM PRATENSE*, L. (Timothy).

Introduced, perennial. No grass is better known or more highly prized by Canadian farmers. On the whole, it is perhaps the most profitable hay grass which can be grown. Though somewhat coarse and hard, especially if allowed to stand too long, yet if cut at the proper time, it makes excellent hay, greedily eaten by horses and cattle. The great advantages of Timothy are, its growth is vigorous, the hay is heavy, it is easily cured and can be handled and pressed without waste and it is of recognized value, owing to which it meets with a ready sale. The seed is freely produced, easily saved, cleaned and handled. Moreover, it is always obtainable in the market when required. Timothy, however, has some defects which must not be overlooked: when cut too early, the bulbs at the bases of the stems are injured, so that only a weakly growth is produced afterwards. These bulbs also make it particularly susceptible to injury by mice and insects. It is unsuitable for pastures, as horses, sheep and pigs crop it too close, when it is apt to be winter-killed. There is practically no aftermath. All of these points go to show that Timothy is not a perfect grass, and it would be well for farmers throughout the country to supplement their pastures and meadows with other varieties which up to the present have been much neglected, and deemed unworthy of notice as producers of "wild hay."

The analyses here given, showing the composition of the plant taken while spearing and after the seed had become mature, afford an excellent illustration of the depreciation in nutritive value which takes place in the latter stages of the plant's life, and point unmistakeably to a grave error when Timothy is allowed to ripen its seed before mowing. The large decrease in the most valuable of all the constituents, viz., the albuminoids, is accompanied by an increased percentage of fibre, which by this time has become very hard and indigestible.

Nos. 45 & 46.—*POA COMPRESSA*, L. (Canada Blue Grass, Wire Grass).

—Fig. 7.



Fig. 7.—Canada Blue grass.

Native, perennial. A rather small species, somewhat resembling June grass, but easily distinguished by its numerous flat stems. This is a very hardy grass, which withstands the effects of drought and will thrive in almost any soil. Thus it is particularly well suited for rocky pastures. It flowers about the 1st of July, but the stems remain green for a long time, and it makes fair hay even when the seeds are ripe. The hay although short is very heavy and rich. When fed green to cattle, they appear to prefer it to all other grasses. The analyses show it to be low in water and consequently rich in dry matter—which constitutes the real cattle food. It compares most favourably with the best in the amount of albuminoids. The statement made, when speaking of Timothy, concerning the loss of albuminoids and the increase of fibre as the plant matures, receives another illustration in the analyses of this grass.

POA NEMORALIS, L. (Wood Meadow Grass).

A small rich European grass, closely resembling our native *Poa serotina*.

No. 47.—*POA NEVADENSIS*, Vasey (Nevada Bunch Grass).

Native, perennial. A small species of bunch grass, which on the western plains helps to make up the supply of rich pasturage found there. From its small size, this grass is scarcely worthy of cultivation, even in the west. Flowering period, June 15 to 30. Height, 1 foot. As regards nutritive qualities, our analyses prove its dry matter to be rich in flesh-forming constituents.

Nos. 48 & 49.—*Poa PRATENSIS*, L. (June Grass, Kentucky Blue Grass)*

—Fig. 8.



Fig. 8.—June grass.

Native, perennial. This grass is as a rule not so highly valued by farmers as it deserves. This is perhaps due to the fact that its chief value is in its leaves, which although freely produced from early in the spring till late in the autumn are not always recognized as belonging to the weak flowering stems which appear in June. There are also various forms, some of which are much better agriculturally than others. We have under cultivation at the Experimental Farm eight of these forms which are very distinct. On the whole, however, we consider June grass as undoubtedly the most valuable pasture grass in the country. All stock relish it. If kept fed off, it produces more continuously than any other grass.

The percentage of albuminoids in the young grass is above the average, making it a rich and nutritious fodder. The analyses bear out and confirm the good opinion expressed of this grass as an excellent one for all pasture mixtures.

No. 50.—*Poa PRATENSIS*, "White form."

Native, perennial. Grown from seed collected in the North-west Territories. This is a very early handsome form with wide pale leaves and conspicuously glaucous panicles, which become very much contracted. It is almost a bunch grass producing very few and short runners. It is not unlike some forms of *Poa cæsia*. Flowering period, June 1 to 15. Height, 2 to 2½ feet; leaves, 1 foot

long. It is proved by analysis to be a rich grass. It is high in dry matter and albuminoids and low in fibre. Taken at the same stage of growth, it will be seen to be very similar in composition to *Poa pratensis*.

Nos. 51 & 52.—*POA SEROTINA*, Ehrh. (Fowl Meadow Grass).

Native, perennial. A fine soft grass producing an abundance of slender stems which remain green a long time after the seed is ripe. This excellent grass has been sparingly cultivated for 150 years. It grows well in low grounds, and gives almost as heavy an aftermath at the end of August as the first crop which is ready for cutting in the beginning of July. The hay is soft, possesses high nutritive qualities and is well liked by stock. Flowering period, July 1 to 10. Height, 18 inches to 2 feet.

No. 53.—*SETARIA GLAUCA*, Beauv. (Yellow Fox-tail).

Annual, originally introduced, but now a common weed all through North America. Of no agricultural value, although occasionally found growing luxuriantly in stubble and waste places. Flowering period, August. Height, 1 to 2 feet. It cannot be considered a rich grass, though when young it possesses nutritive qualities of value.

No. 54.—*SETARIA ITALICA*, Kunth. (Hungarian Millet, Bengal Grass).

Introduced, annual. A valuable grass for a catch crop, owing to its rapidity of growth and the late date at which it may be sown. It succeeds well on dry light land and produces a heavy crop of hay, which must be cut early. Height, 2 to 2½ feet. It is not among the best grasses, rapidly deteriorating as it matures so as to be practically worthless when ripe, save for the seeds. The young crop, however, furnishes a wholesome and valuable fodder.

No. 55.—*SPOROBOLUS HETEROLEPIS*, Gray (Fetid Drop-seed Grass).

A native perennial grass of the plains, producing many long fine leaves. This grass will grow in almost pure sand or in stiff clay. When in flower, it emits a strong peculiar unpleasant odour which may be detected for a long distance from the plants. Animals eat the leaves readily, but they reject the flowering stems. Flowering period, July 15 to 25. Height, 2 feet. The high percentage of dry matter and its fair composition give it a place among the grasses of good quality.

GENERAL CONCLUSIONS FROM THE ANALYTICAL DATA.

PERIOD AT WHICH TO CUT FOR HAY.

A study of the table will show that the following general changes take place in the composition of grasses as they approach maturity: The water, ash, albuminoids and fat decrease, while the fibre, and usually the nitrogen-free extract, increases. In the case of the three first named constituents, there are but very few exceptions to this rule. The drying out of the grasses as they mature is universal, and for this reason the very young grass shoots are more succulent and palatable than the leaves and stems of the older plant, though not containing, weight for weight, as much dry matter.

It has already been mentioned that the composition of a grass is not constant under all circumstances, but is much affected by environment; the percentages of ash and of albuminoids depend largely on the richness of the soil, and as they vary, so must the other constituents vary. But there are exceedingly few instances in which the percentages of ash and albuminoids in the dry matter do not gradually decrease as the plant grows older. It is during the early stages of the plant's life that it more particularly takes its mineral constituents and nitrogen from the soil. As the grass increases in size and is about to form its seed, the ash and the nitrogen, representing the albuminoids, being now taken up by the roots in lessening quantities, are distributed throughout a greater bulk of the plant, and thus their percentage in the dry matter is reduced. The decrease in amount of ash is not important from a feeding standpoint, but the diminution of the albuminoids presents an important problem when considering the best time at which to cut for hay.

The "ether extract" or "crude fat" also decreases, but since it possesses but a small percentage of true fat or oil, this cannot be looked upon as a serious deterioration.

The fibre of the dry matter not only increases in amount, but also in indigestibility, as the plant matures, becoming hard and woody. This is almost invariably the case.

From the conclusions, drawn from a careful consideration of the chemical data, it may be inferred that a loss of much valuable and digestible food material occurs when a grass is allowed to mature before it is cut for hay. The weight of scientific evidence is all in favour of cutting at, or shortly after the flowering period,

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though the exact stage at which it would be most economical to cut any particular grass has as yet not been ascertained with accuracy. Regarding this question, Dr. Clifford Richardson, of Washington, who has made a study of the composition of American grasses, says : " Although largely a matter of opinion, it would seem from the foregoing (chemical) results that the time of bloom or very little later is the fittest for cutting grasses to be cured as hay. The amount of water has diminished relatively, and there is a proportionately larger amount of nutriment in the material cut, and the weight of the latter will be at its highest point economically considered. Later on, the amount of fibre becomes too prominent, the stalks grow hard, arid, indigestible, and the albuminoids decrease, while the dry seeds are readily detached from their glumes and lost with their store of nitrogen."*

Much of the nutriment, and more particularly of the albuminoids, passes from the stem and leaves to be stored up in the seed as the plant matures; the stems and foliage are thus more or less impoverished of their most valuable constituent, and as already pointed out, their fibre is rapidly increasing both in amount and indigestibility. In harvesting a grass with ripened seed, much loss of the latter must ensue. Added to this, there is the fact that many ripe seeds, enclosed in their hard integuments, pass through the animal undigested. It is, therefore, obvious on all counts that the advice given above should be followed out.

II.—GRASSES FROM MANITOBA AND THE NORTH-WEST TERRITORIES.

Samples of some of the more commonly occurring prairie grasses were gathered by the Superintendents of the Experimental Farms at Brandon and Indian Head, in the condition of hay. The analyses, therefore, represent their composition as cropped by stock in the natural, dry state. This, of necessity, implies that they were not procured in the condition at which experiment has proved grasses are the most nutritious; most of them were fully ripe and some had shed their seed. They, therefore, must not be compared strictly with those grasses already commented upon, which were grown under good cultivation and cut, for the most part, at the right period of growth. Considering the great deterioration that takes place as grass ripens, and the result of our present analyses, we may

*Vasey, G. *The Agricultural Grasses of the United States*, Washington, 1889, p. 138.

safely infer that many of the native grasses of the prairies are of a highly nutritious order, possessing valuable feeding qualities and further, that the conditions of climate, and especially the absence of late rains, tend to the preservation of the valuable pasture constituents in the naturally cured grasses.

Under cultivation and if cut earlier, many of these grasses would undoubtedly show a great improvement in composition. The rich, fertile character of most of the soil in Manitoba and the North-west Territories and the heavy yields of native prairie grasses are facts widely known. In addition, we have the strong probability, proved in the case of wheat, a member of the grass family, that the short season is conducive to an early and large development of the albuminoids. The indications, therefore, are that with due care and in a favourable season, pasture and meadow grasses may be grown equal, if not superior, to those of any part of Canada.

The usual amount of water in old country hay is stated at 14 per cent; in these North-west hays it was invariably in the neighbourhood of 8 per cent, and therefore their composition was calculated upon that basis. From our data it may fairly be inferred that the naturally cured grasses of the prairie do not contain more than this amount. They consequently are rich in dry matter and thus afford to grazing cattle a correspondingly greater amount of real cattle food (though not quite so rich in the flesh forming albuminoids) than an equal weight of hay produced in a moister climate.

Many of the grasses whose composition is here tabulated have already been commented upon. The character and agricultural value of the remainder will now be given.

No. 62.—*AGROSTIS SCABRA*, Willd. (Tickle Grass).

A common native species with hair-like root leaves and very large loosely flowered panicles. Of no agricultural value. Height, 1 foot. In composition it is very similar to *A. vulgaris*, already treated of (No. 7).

Nos. 65 AND 66.—*ANDROPOGON PROVINCIALIS*, Lam. (Turkey-foot).

Native, perennial. A strong growing grass, found in dry soil. Where it occurs, it is highly valued both for hay and pasture, but we do not know of its having been cultivated. The stems are leafy and when young eaten with avidity by stock. They become

hard and woody after flowering. Flowering period, August. Height, 3 to 4 feet. This sample was evidently taken too late to give a correct idea of its composition at the stage when it is relished by stock. (Identical with *A. furcatus*, Michx.).

Nos. 67 AND 68.—*ANDROPOGON SCOPARIUS*, Mx. (Indian Grass).

Native, perennial. More slender than the last and very much of the same nature agriculturally. Height, 2½ feet. Our analyses show it is inferior to the preceding, though this may be partially due to its age when taken.

No. 69.—*AMMOPHILA LONGIFOLIA*, Vasey (Woolly Reed Bent Grass).

Native, perennial. A tall reed-like grass. Abundant throughout the prairie region on sandy ridges, with hard stems and long slender leaves. Flowering period, August. Height, 4 to 5 feet. We have not yet had an opportunity of determining the agricultural value of this grass.

No. 70 & 71.—*BECKMANNIA ERUCÆFORMIS*, Host., var. *UNIFLORUS*, Scrib. (Slough Grass).

Native, perennial. A tall coarse grass of the west, making remarkably soft hay. It grows naturally in wet sloughs or low ground. In many parts of Manitoba and the North-west Territories, it is abundant and forms valuable fodder much relished by cattle. Flowering period, June 15 to 30. Height, 2 to 3 feet. These samples undoubtedly represent the plant in two stages of growth. It will be noticed that No. 71 is much more valuable than No. 70, containing twice the amount of albuminoids and being consequently more nutritious.

No. 73.—*BROMUS KALMI*, Gray (Kalm's Brome Grass).

Native, perennial. A small hairy species, found in dry rocky woods. Flowers in June. Height, 18 inches to 2½ feet. Of no agricultural value.

No. 78.—*ELYMUS AMERICANUS*, V. & S.

Native, perennial. A slender grass somewhat resembling *Elymus Canadensis*, but finer and less robust. Flowering period, July 20 to August 1. Height, 2½ to 3½ feet. We are not in possession of

sufficient data to enable us to pronounce definitely as to the agricultural value of this variety.

Nos. 79 & 80.—*ELYMUS CANADENSIS*, L. (Canadian Lyme Grass).

Native, perennial. A coarse grass found on river banks and among the bushes in low ground. From our experience at Ottawa, it is apparently not very suitable for cultivation in open fields. Flowering period, July 20 to August 1. Height, 4 to 6 feet. It requires to be cut early to make good hay. In composition it compares most favourably with other wild grasses from the North-west and from this aspect must be considered as possessing considerable value.

No. 81.—*GLYCERIA AQUATICA*, Sm. (Reed Meadow Grass).

Native, perennial. A tall soft, succulent grass, with a large panicle and broad leaves, found growing in wet soil and swampy meadows. This grass produces a large quantity of coarse hay and is eaten readily by cattle when cut green. It is one of the few good grasses which will grow actually in water. Flowering period, July. Height, 4 feet. The analysis shows it to be possessed of high nutritive qualities.

Nos. 88, 89, 90.—*SPARTINA CYNOSUROIDES*, Willd. (Fresh-water Cord Grass).

Native, perennial. A tall slender grass found on banks of streams and in marshes. In the Maritime Provinces it is very much cut for hay and is highly esteemed under the name of "Broad-leaf." It is claimed to have high feeding value by some, but others state that it is very poor feed, and has little worth beyond the bulk that it gives to a hay crop, and the artificial value due to its having a good name. Flowering period, August. Height, 5 to 6 feet. Sample No. 90 was obtained from the Maritime Provinces. It is considerably below the average in albuminoids and possesses a high percentage of fibre. Samples 88 and 89 from the North-west appear somewhat better.

No. 92.—*SPOROBOLUS CUSPIDATUS*, Scrib.

Native, perennial. A small, hair-like species, of no bulk nor agricultural value. In composition it is seen to rank as a fair grass as regards albuminoids, though too high in fibre to be placed with the better varieties here mentioned.

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TABLES OF ANALYSES OF GRASSES.

I.—ANALYSES of Grasses grown at the Central Experimental Farm,
Ottawa.

II.—ANALYSES of Grasses from Manitoba and the North-west
Territories.

I.—ANALYSES of Grasses grown at

No.	Name.	Stage of growth.
1	<i>Agropyrum caninum</i> , Bearded Wheat grass.	Just before spearing.
2	" "	In flower.
3	" <i>glaucum</i> , Colorado Blue-stem.	Not speared, leaves only.
4	" "	In flower.
5	" <i>repens</i> , Quack.	"
6	" <i>tenerum</i> , Western Rye grass.	Seeds fully formed.
7	<i>Agrostis vulgaris</i> , Red top.	In flower.
8	" <i>dispar</i> .	"
9	<i>Alopecurus pratensis</i> , Meadow Fox-tail.	"
10	<i>Bouteloua oligostachya</i> , Gramma grass.	"
11	<i>Bromus ciliatus</i> , Fringed Brome grass.	"
12	" <i>inermis</i> , Awnless Brome grass.	Speared; anthers not extruded.
13	" "	Seed fully formed.
14	" <i>Pumpellianus</i> , Western Brome grass.	Speared; flowers not expanded.
15	" "	Seed fully formed.
16	" <i>segetum</i> .	In flower.
17	<i>Buchloe dactyloides</i> , Buffalo grass.	"
18	<i>Ceratochloa australis</i> , Southern Brome grass.	"
19	<i>Cinna pendula</i> , Drooping Reed grass.	"
20	<i>Deschampsia cespitosa</i> , Tufted Hair grass.	Seed just formed.
21	" <i>cespitosus</i> , var. <i>Botttnica</i> , Rocky Mountain Hair grass.	In flower.
22	<i>Deyeuxia Canadensis</i> , Canadian Blue-joint.	Seed ripe.
23	" <i>neglecta</i> , Neglected Blue-joint.	Seed just formed.
24	<i>Eleusine Indica</i> , Crow-foot grass.	Seed formed.
25	<i>Elymus Virginicus</i> , Lyme grass.	In flower.
26	<i>Eragrostis abyssinica</i> , Teff.	Seed formed.
27	<i>Festuca elatior</i> , Tall Fescue.	Speared; flowers not expanded.
28	" "	In flower.
29	" <i>pratensis</i> , Meadow Fescue.	Just speared.
30	" "	Seed formed.
31	<i>Hierochloa borealis</i> , Holy grass.	Seed half ripe.
32	<i>Holcus lanatus</i> , Velvet grass.	Just past flowering.
33	<i>Koeleria cristata</i> , Western June grass.	Spikes in sheath.
34	" "	Seeds fully formed.
35	<i>Lolium perenne</i> , Perennial Rye grass.	In flower.
36	<i>Muhlenbergia glomerata</i> , Wild Timothy.	"
37	" <i>Mexicana</i> , Satin grass.	Seed formed.
38	<i>Panicum capillare</i> .	In flower.
39	" <i>Crus-galli</i> , Barn-yard grass.	"
40	" <i>virgatum</i> , Switch grass.	Leafy stem; not in flower.
41	<i>Phalaris arundinacea</i> , Reed Canary grass.	Just speared.
42	" "	Seed formed.
43	<i>Phleum pratense</i> , Timothy.	Just past flowering.
44	" "	Seed formed.
45	<i>Poa compressa</i> , Wire grass.	Seed formed.
46	" "	Seed formed.

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78·08

85·30

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80·16

79·07

65·18

62·15

57·88

the Central Experimental Farm, Ottawa.

IN FRESH OR GREEN MATERIAL.							CALCULATED TO WATER-FREE SUBSTANCE.						
Water.	Ash.	Protein (Albaninoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).	Ash.	Protein (Albaninoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).			
72.33	2.11	6.82	5.96	11.41	1.37	7.64	24.68	22.00	47.40	4.94			
66.14	1.64	2.98	14.33	14.97	.51	4.86	8.81	42.34	42.48	1.51			
75.76	1.64	4.44	5.97	11.09	1.10	6.76	18.31	24.62	45.73	4.58			
63.21	1.75	4.48	12.87	16.44	1.25	4.75	12.19	34.99	44.67	3.40			
72.88	2.02	4.54	8.15	11.57	.84	7.45	16.75	30.03	42.66	3.11			
62.51	2.14	5.27	14.74	14.97	.37	5.71	14.06	39.35	39.90	.98			
61.62	2.29	3.09	13.95	17.95	1.10	5.99	8.06	36.36	46.71	2.88			
60.39	2.37	3.44	12.50	20.64	.66	5.99	8.69	31.54	52.11	1.67			
81.53	1.66	2.25	6.21	7.82	.53	9.04	12.18	33.67	42.24	2.87			
63.02	3.12	4.99	11.18	17.23	.42	8.45	13.50	30.24	46.65	1.16			
57.68	1.66	3.94	14.06	21.85	.81	3.03	9.31	33.23	51.62	1.91			
81.78	1.73	3.21	6.14	5.50	1.64	9.03	17.62	33.72	35.42	4.21			
65.07	1.32	4.14	11.73	16.90	.84	3.78	11.88	33.90	48.03	2.41			
77.32	1.81	3.61	7.46	13.94	.87	8.00	15.93	32.71	39.51	3.85			
62.33	1.61	4.35	10.93	19.81	.97	4.28	11.58	29.05	52.51	2.58			
78.17	1.89	4.18	6.69	8.62	.45	8.69	19.18	26.12	43.95	2.06			
59.86	2.73	4.81	11.62	20.57	.41	6.81	12.00	28.97	51.37	.85			
80.33	1.64	3.24	6.36	8.01	.42	8.30	16.50	33.37	39.66	2.17			
68.00	2.98	6.75	7.86	13.60	.81	9.32	21.12	24.58	42.43	2.55			
57.13	2.15	3.53	15.41	21.23	.55	5.03	8.25	35.98	49.44	1.30			
68.03	1.66	4.49	10.04	15.22	.56	5.19	14.06	31.35	47.65	1.75			
56.69	2.02	4.57	16.06	19.28	1.38	4.68	10.56	36.09	45.49	3.18			
67.64	2.29	5.76	9.93	13.34	1.04	7.07	17.81	30.71	41.18	3.23			
76.46	2.32	3.53	6.61	10.75	.33	9.88	15.00	28.12	45.59	1.41			
68.38	1.26	2.62	11.34	16.01	.39	4.04	8.29	39.04	47.38	1.25			
67.73	2.20	4.33	10.16	14.99	.59	6.83	13.43	31.48	46.44	1.82			
76.63	1.61	3.84	6.98	10.12	.82	6.90	16.43	29.86	43.31	3.50			
74.38	1.72	2.93	9.88	10.55	.54	6.73	11.44	38.61	41.08	2.14			
78.01	1.50	3.63	6.37	9.67	.82	6.84	16.50	28.97	43.94	3.75			
70.31	2.45	4.91	7.96	13.97	.40	8.28	16.56	26.27	47.55	1.34			
75.32	1.64	4.93	6.14	10.68	1.29	6.63	20.00	43.25	24.88	5.24			
73.31	2.24	4.11	6.88	12.91	.55	8.40	15.43	25.79	48.30	2.08			
71.65	1.95	6.73	6.78	11.08	1.81	6.86	23.75	23.93	39.08	6.38			
57.88	2.60	5.31	16.77	16.89	.75	6.18	12.62	39.85	39.56	1.79			
79.40	1.59	2.12	6.22	10.17	.50	7.72	10.50	30.83	48.44	2.51			
62.72	2.86	5.40	11.19	17.37	.46	7.67	14.50	30.03	46.56	1.24			
49.78	2.39	4.64	14.92	27.59	.68	4.77	9.25	29.72	54.91	1.35			
78.08	1.64	2.61	5.22	11.95	.50	7.50	11.94	23.83	54.46	2.28			
85.30	1.64	2.02	4.48	6.25	.31	11.16	13.75	31.09	41.87	2.13			
68.03	1.50	2.14	11.03	16.54	.71	4.72	6.69	34.68	51.69	2.22			
67.55	2.22	5.39	7.35	16.62	.87	6.84	16.62	22.67	51.19	2.68			
80.16	1.31	3.00	5.69	9.40	.44	6.61	15.12	28.62	47.43	2.22			
79.07	1.71	3.51	5.84	9.03	.84	8.18	16.79	28.43	42.58	4.02			
65.18	1.34	2.86	10.63	19.47	.52	3.84	8.22	30.54	55.90	1.50			
62.15	2.24	3.83	9.67	21.47	.64	5.93	10.13	26.09	56.16	1.69			
57.50	2.35	3.50	12.42	23.27	.96	5.53	8.24	29.24	54.72	2.27			

I.—ANALYSES of Grasses grown at the Central

No.	Name.	Stage of growth.
47	Poa Nevadensis, Nevada Bunch grass	Just speared
48	" pratensis, June grass	Flowers formed, but anthers not extruded
49	" "	Seed formed
50	" " "white form"	Flowers formed, but anthers not extruded
51	" serotina, Fowl Meadow grass	Just speared
52	" "	In flower and seed
53	Setaria glauca, Yellow Fox-tail	"
54	" Italica, Hungarian Millet	In flower
55	Sporobolus heterolepis, Fetid Drop-seed grass	Seed formed

the Central

Experimental Farm, Ottawa—Concluded.

	IN FRESH OR GREEN MATERIAL.						CALCULATED TO WATER-FREE SUBSTANCE.				
	Water.	Ash.	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).	Ash.	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).
anthers not	72·55	1·43	5·26	8·92	10·70	1·14	5·22	19·18	32·15	39·29	4·16
anthers not	69·55	1·99	5·70	8·89	12·40	1·47	6·53	18·75	29·19	40·71	4·82
.....	66·43	1·66	3·31	11·10	16·48	1·02	4·94	9·87	32·07	50·06	3·06
.....	65·91	1·64	5·73	7·90	17·46	1·36	4·80	16·81	23·16	51·23	4·00
.....	72·83	2·03	4·12	7·19	12·73	1·10	7·49	15·18	26·50	46·77	4·06
.....	67·57	2·18	3·93	11·83	13·54	·95	6·74	12·12	36·48	41·73	2·93
.....	75·09	2·04	2·00	7·15	13·25	·47	8·21	8·06	28·73	53·09	1·90
.....	68·06	1·91	2·91	9·40	17·24	·48	6·00	9·13	29·44	53·93	1·51
.....	55·45	2·10	4·79	12·61	24·59	·46	4·73	10·75	28·32	55·17	1·03

II.—ANALYSES of Grasses from Manitoba

No.	Name.	HAY		
		Water.	Ash.	
56	* <i>Agropyrum caninum</i> , Bearded Wheat grass.....	8'00	5'50	
57	+ " "	8'00	5'92	
58	* " <i>glaucum</i> , Colorado Blue-stem.....	8'00	7'97	
59	+ " "	8'00	10'26	
60	* " <i>tenerum</i> , Western Rye grass.....	8'00	5'32	
61	+ " "	8'00	7'23	
62	<i>Agrostis scabra</i> , Tickle grass.....	8'00	7'84	
63	* " <i>vulgaris</i> , Red Top.....	8'00	8'28	
64	* <i>Deschampsia caespitosa</i> , Tufted Hair grass.....	8'00	5'80	
65	+ <i>Andropogon provincialis</i> , Turkey-foot.....	8'00	7'92	
66	* "	8'00	5'08	
67	* " <i>scoparius</i> , Indian grass.....	8'00	4'86	
68	+ " "	8'00	8'09	
69	+ <i>Ammophila longifolia</i> , Woolly Reed Bent grass.....	8'00	4'94	
70	* <i>Beckmannia eruciformis</i> , Slough grass.....	8'00	7'58	
71	+ " "	8'00	10'30	
72	+ <i>Bromus ciliatus</i> , Fringed Brome grass.....	8'00	7'08	
73	+ " <i>Kalmii</i> , Kalm's Brome grass.....	8'00	4'53	
74	* " <i>Pumpellianus</i> , Western Brome grass.....	8'00	4'68	
75	+ <i>Deyeuxia Canadensis</i> , Canadian Blue-joint.....	8'00	10'11	
76	* " <i>neglecta</i> , Neglected Blue-joint.....	8'00	6'67	
77	+ "	8'00	9'59	
78	+ <i>Elymus Americanus</i>	8'00	6'44	
79	* " <i>Canadensis</i> , Canadian Lyme grass.....	8'00	7'77	
80	+ "	8'00	9'04	
81	+ <i>Glyceria aquatica</i> , Reed Meadow grass.....	8'00	10'12	
82	+ <i>Molinia glomerata</i> , Wild Timothy.....	8'00	6'05	
83	+ " <i>Mexicana</i> , Satin grass.....	8'00	8'36	
84	+ <i>Phalaris arundinacea</i> , Reed Canary grass.....	8'00	8'92	
85	* <i>Poa serotina</i> , Fowl Meadow grass.....	8'00	8'17	
86	+ "	8'00	10'19	
87	+ "	8'00	5'69	
88	* <i>Spartina cynosuroides</i> , Fresh-water Cord grass.....	8'00	4'61	
89	+ "	8'00	5'98	
90	+ " " " Broad-leaf"	8'31	4'53	
91	+ <i>Sporobolus heterolepis</i> , Fetid Drop-seed grass.....	8'00	4'94	
92	* " <i>cuspis</i>	8'00	5'36	

*Collected at Indian Head, N.W.T.

† " Brandon, Man.

‡ " Sackville, N.B.

and the North-west Territories.

HAY

Ash.

	OF GRASSES.			CALCULATED TO WATER-FREE SUBSTANCE.							
	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates)	Ether extract (Fat).		Ash.	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates)	Ether extract (Fat).	
5·50	5·65	38·52	41·03	1·29	5·98	6·15	41·87	44·60	1·40		
5·92	5·53	41·92	36·60	2·03	6·44	6·01	45·56	39·78	2·21		
7·97	6·86	43·89	31·48	1·80	8·66	7·46	47·70	34·22	1·96		
10·26	12·59	36·37	29·05	3·73	11·15	13·68	39·53	31·58	4·06		
5·32	5·13	38·34	44·44	1·77	5·79	5·58	38·41	48·30	1·92		
12·59	6·41	37·35	39·26	1·75	7·85	6·97	40·60	42·68	1·90		
7·23	8·28	33·18	41·28	1·42	8·52	9·00	36·07	44·87	1·54		
7·84	8·10	38·46	34·75	2·41	9·00	8·81	41·80	37·77	2·62		
8·28	4·22	38·56	42·28	1·14	6·30	4·59	41·91	45·96	1·24		
5·80	5·50	36·57	39·05	2·87	8·61	6·08	39·75	42·44	3·12		
7·92	6·01	43·80	35·82	1·29	5·52	6·53	47·61	38·94	1·40		
5·08	4·48	36·65	44·85	1·21	5·29	4·80	39·84	48·75	1·32		
4·86	4·08	41·78	36·22	1·88	8·80	4·43	45·42	39·36	1·99		
8·09	6·73	35·44	41·98	2·91	5·37	7·32	38·52	46·63	3·16		
4·94	8·00	42·29	31·01	3·12	8·24	8·68	45·97	33·71	3·39		
7·58	15·76	26·31	35·31	4·32	11·20	17·18	28·60	38·38	4·69		
10·30	9·03	27·27	45·74	2·88	7·70	9·82	29·64	49·71	3·13		
7·08	5·52	35·15	45·17	1·63	4·93	6·00	38·21	49·10	1·76		
4·68	4·29	38·48	42·54	2·01	5·09	4·66	41·83	46·23	2·19		
10·11	8·51	39·69	30·80	2·89	10·99	9·25	43·14	33·48	3·14		
6·67	5·04	37·69	40·93	1·67	7·25	5·47	40·97	44·49	1·82		
9·59	6·82	35·05	36·27	4·27	10·43	7·40	38·10	39·43	4·64		
6·44	7·18	26·90	49·41	2·07	7·00	7·80	29·24	53·71	2·26		
7·77	11·87	33·56	36·73	2·07	8·45	12·90	36·48	39·92	2·26		
9·04	13·17	32·13	35·18	2·48	9·83	14·32	34·92	38·24	2·69		
10·12	11·87	34·55	34·43	1·08	11·00	12·90	37·56	37·42	1·12		
6·05	8·28	37·05	37·51	3·11	6·58	9·00	40·27	40·77	3·38		
8·36	4·89	43·17	33·56	2·02	9·09	5·32	46·92	36·47	2·20		
8·92	12·26	23·07	43·33	4·42	9·69	13·33	25·08	47·09	4·81		
8·17	4·89	35·38	41·95	1·61	8·88	5·31	33·46	45·60	1·75		
10·19	7·66	40·20	32·62	1·33	11·08	8·32	48·70	35·45	1·45		
5·69	6·22	32·95	44·44	2·70	6·19	6·75	35·81	48·31	2·94		
4·61	5·52	38·66	42·36	1·85	5·01	6·00	42·02	46·05	.92		
5·98	5·11	38·46	41·09	1·36	6·50	5·55	41·81	44·66	1·48		
4·53	3·66	33·69	47·92	1·89	4·94	3·99	36·47	52·54	2·06		
4·94	6·74	35·44	41·98	2·90	5·37	7·32	38·52	45·63	3·16		
5·36	8·13	46·23	30·93	1·35	5·83	8·83	50·25	33·62	1·47		

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